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Kyoto University

Interface Science
- Hydrospheric Environment Analysis -

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Instr PENG, Xiuhong — Chengdu University of Technology, Sichuan, China, 27 October 2003 - 15 January 2004

Scope of Research

Research activities are concerned with geochemistry, oceanography, limnology and analytical chemistry, which are important basic sciences in order to realize the sustainable society. Major research subjects are as follows: (i) Biogeochemistry of trace elements in the hydrosphere. (ii) Hydrothermal activity and deep biosphere on the ocean floor. (iii) Fe-uptake mechanism of phytoplankton. (iv) Ion recognition. (v) Simulation of non-linear chemical reaction.

Research Activities (Year 2003)

Presentations

Analysis and dynamics of trace metals in the ocean. Sohrin Y, 23rd Professor Masayoshi Ishibashi Memorial Lecture, 28 April.

Chemical oceanography by using in-situ chemical analyzers. Okamura K, The 64th conference on the Japan Society for Analytical Chemistry, 24 May 2003.

Design of solvent extraction system as separation and concentration methods for metal ions. Umetani S, The 64th conference on the Japan Society for Analytical Chemistry, 24 May 2003.

Dynamics of dissolved and dissolvable trace metals during the subarctic pacific iron experiment for ecosystem dynamics study (SEEDS 2001), Kinugasa M, Sohrin Y, Ishita T, Takeda S, Nishioka J, Tsuda A, IUGG2003, 4 July.

Zr, Nb, Hf, Ta, and W in the northwest Pacific Ocean, Sohrin Y, Mikata M, Minami T, Norisuye K, Goldschmidt Conference 2003, 12 September.

Grants

Sohrin Y, Dynamics of trace bioelements in the ocean and its effect on ecosystem, Grant-in-Aid for Scientific Research (B) (1), 1 April 2001 - 31 March 2004.

Okamura K, Development of in situ measurement system of CO_2 related matter in seawater for global warming control, NEDO Grant, 1 April 2001 - 31 March 2004.

Okamura K, Development of time-series measurement system of sulfur related matter in seawater, Grant-in-Aid for Young Scientists B, 1 April 2003 - 31 March 2006.

Award

Sohrin Y, 18th Oceanochemistry Award (Research Institute of Oceanochemistry)

Dynamics of trace metals during the subarctic Pacific iron experiment for ecosystem dynamics study (SEEDS2001)

During the first iron-enrichment experiment in the northwest subarctic Pacific (SEEDS2001), the dynamics of dissolved and acid-dissolvable trace metals were studied. Before the Fe enrichment, the dissolved Fe concentration in the surface mixed layer was <0.13 nM (the detection limit) and the acid-dissolvable Fe concentration was 4.7 nM. The difference derived from a particulate fraction including Fe in organisms. Since the photochemical quantum efficiency of algal photosystem II was low, Fe in this fraction was not easily available to phytoplankton. After the Fe enrichment, acid-dissolvable Fe in the patch decreased from 9.6 nM on day 2 to 4.6 nM on day 13, which was still ~3 nM higher than that at the Out-patch station. Dissolved Fe was 1.4 nM on day 2 and decreased exponentially to <0.13 nM on day 11. The concentration ratio of the acid-dissolvable fraction to the dissolved fraction was lower for the other trace metals than that for Fe. The acid-dissolvable concentrations for Mn, Co, Ni, Cu, Zn and Cd did not show significant change during the observation. The dissolved concenrations for Co, Ni, Cu, Zn and Cd in the surface layer on day 2 were 0.039, 5.0, 1.7, 2.2 and 0.27 nM, respectively. They decreased exponentially to 0.013, 4.3, 1.2, 0.87 and 0.21 nM on day13, respectively. The mole ratio of the concentration difference between days 2 and 13 was $Si(OH)_4 : NO_3 : PO_4 : Fe : Zn : Ni : Cu : Cd = 27 : 16 : 1 : 1 \times 10^{-3} : 1 \times 10^{-3} : 6 \times 10^{-4} : 4 \times 10^{-4} : 5 \times 10^{-5}$, which was similar to the elemental ratio reported for phytoplankton. These are the first data showing that mesoscale iron fertilization alters the dynamics of dissolved Co, Ni, Cu and Zn.

Distributions of dissolved and acid dissolvable bioactive trace metals in the North Pacific Ocean

Dissolved and acid dissolvable Fe, Co, Ni, Cu, Zn, Cd and Pb were measured in the North Pacific Ocean (40-17°N, 151°E-160°W) in June-July 2000.

Profiles of dissolved and acid dissolvable Fe show a large intra-basin variation. The concentrations are 0.3-1.4 nM for dissolved Fe (D Fe) and 0.7-4.7 nM for acid dissolvable Fe (AD Fe) in deep water. The concentrations are high at stations in the northwestern area and southwest off the Hawaiian Islands. AD Fe increases below 4000 m suggesting resuspension of sedimentary material. For Co, Ni, Cu, Zn, and Cd, the concentrations of dissolved and acid dissolvable species mostly agree within an experimental error. Deep water distributions of Ni, Cu, Zn, and Cd are fairly uniform in the basin. AD Pb is significantly higher than D Pb especially in surface water.

Comparison to our previous data (Fujishima et al., 2001) in the subarctic North Pacific in July-September 1997 indicates the heterogeneous distributions of the bioactive trace metals in the surface mixed layer in the North Pacific. In the subtropical region, chlorophyll biomass is very low owing to depletion of major nutrients, resulting in surface maxima of D Fe and D Zn. In the subarctic region, D Fe and D Zn are depleted in the surface mixed layer. In contrast, D Co and D Ni are high in the northwestern subarctic area and low in the subtropical gyre.

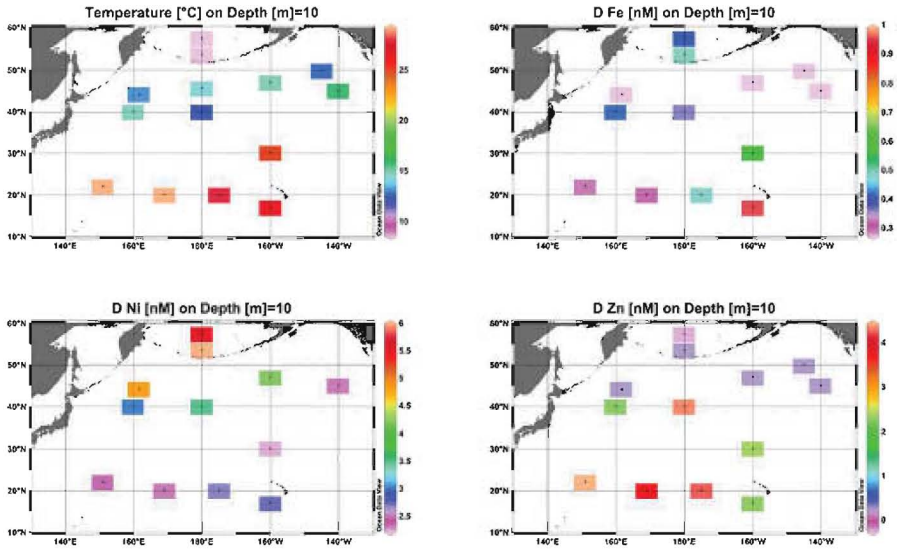

Figure. The horizontal distributions of water temperature, D Ni, D Fe, and D Zn at a depth of 10 m.